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EVALUATION OF NEW CONTAINERS FOR SCHOOL MILK

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SUMMARY

This study was made to evaluate two milk containers recently introduced in American schools. One was the new tetrahedral paper container--"tetra" for short--oddly shaped, somewhat like a pyramid with a triangular base. The other was the 5-gallon dispenser can, well established in the commercial and industrial mass feeding field but relatively new and not widely known in schools.

Research findings indicated that both the tetra container and the dispenser can reduced the costs of packing milk. Assuming a production level that would permit an efficient operation, the major, direct in-plant costs of the tetra were computed to be from $3.50 to $5 lower per 1,000 half pints than conventional paper containers, and between the high and low costs observed for glass bottles. Use of dispenser cans permitted savings of from $5 to $9 when compared with the costs of packaging 1,000 conventional paper ½-pint containers.

There was little to choose between the tetra and the conventional ½-pint containers in the school serving operation. Serving milk from cans required substantially more labor and equipment.

In 1958-59 approximately 4.2 billion half pints of milk were served in some 70,000 U. S. schools which ordered their supplies in such containers as they chose. In a free enterprise economy all buyers probably never will gravitate to the same product. However, if dairy plants packaged but 10 percent of the school milk with the lower costs noted above, overall annual savings of about $2 million might reasonably be anticipated.

<u>Materials costs</u> for the tetra were about $3 per 1,000 half pints lower than those for a conventional paper container formed and filled in the dairy, and between the high and the low costs observed for glass bottles and caps. Materials costs for the 5-gallon cans, which had an estimated life of from 1 to 2½ years, were $5 to $9 lower per 1,000 half pints packaged than conventional paper cartons.

<u>Machine ownership costs</u> of the tetra--at the low levels of production observed--were from $0.87 to $2.82 higher per 1,000 half pints packaged than the cost of the conventional machines in the same plants. Operation of the tetra machines at higher levels of output would tend to level these differences. The relatively simple equipment used for washing and filling dispenser cans was lowest in cost.

<u>Direct in-plant labor requirements</u> for the tetra packing operation were relatively low, primarily because three of the four fillers observed were equipped with an automatic case packer and could be operated by one man. The conventional machines of comparable speed all required two men. The can operation was primarily manual and in general required more labor than the conventional ½-pint operations with which it was compared.

Utility requirements for the tetra operation, which needed only electricity, were lower than for any other container except the factory-made flat-top paper carton. Power requirements for cans were relatively low but washing the cans required a substantial volume of hot water.

Overall space requirements for the tetra operation were low; for the cans they were relatively high.

Suitability in delivery was rated high for the tetra because (1) empty cases nested and gave the driver room to work his load, and (2) delivery times were relatively fast. Can deliveries were even faster but drivers complained that cans fit poorly in mixed loads.

Suitability in serving milk in the schools appeared about the same for the tetra and for conventional paper containers. Use of cans required additional labor to draw the milk into glasses and wash the glasses. Also required were a mechanical washer, cleansing materials, hot water, and glasses. (The use of paper cups was not observed.)

Pricing of milk in tetra containers varied considerably. Two dairies sold it at the same price as milk in conventional paper containers. One sold it for $5 less per 1,000 half pints. A fourth dairy started out with tetra containers $2.50 lower but raised the price back to the level of the conventional containers at the end of the first term--thereby losing 45 percent of the tetra business. Although computed combined plant costs of the dispenser can were about $5 to $9 less per 1,000 half pints filled than conventional paper costs, price reductions on milk sold in dispenser cans ranged from $10 to $18 per 1,000 half pints below conventional paper cartons.

Like most new products, the tetra container encountered its share of problems in the development stage. However, it was concluded that some dairy operators, after careful consideration of their local market potentialities, might find it well worth the risk to go after the savings that can be attained in an efficient tetra operation serving the mass feeding field.

It also appeared that the dairies studied underpriced milk in dispenser cans, thus adding to the economic advantage of schools in those areas which served from cans.

EVALUATION OF NEW CONTAINERS FOR SCHOOL MILK

By Goodloe Barry, agricultural economist; Thomas D. Reinbold and Mark R. Enger, industrial engineers, Transportation and Facilities Research Division, Agricultural Marketing Service 1/

INTRODUCTION

Need for Study

Month by month the revolution in packaging gains momentum. New packaging materials are being introduced and the qualities of conventional materials are being altered to meet specific needs. At the same time faster and more efficient ways to form, fill, and handle the package are being developed.

The dairy industry is in the thick of the technological tempest. Bulk handling--packaging on a grand scale--has changed the method of collecting milk from farms the length and breadth of the country. Bottling--one of the oldest forms of packaging for retail distribution--is becoming increasingly efficient. New coating materials and new blends of conventional materials are coming from chemical laboratories for use on conventional paper containers which, themselves, are being made with new refinements. Automatic packouts and case stackers are sharply reducing handling times for both glass and paper.

Taxpayers of the Nation, as well as parents of growing children, are vitally concerned with the milk that is delivered to schools. In 1958-59 the equivalent of 4.2 billion half pints of milk was served to school children with some help from Federal funds. States and communities share in school milk costs. A reduction of but a fraction of a cent per ½-pint in container and packaging costs would reflect an overall dollar saving in the millions.

A comparatively new machine developed in Sweden and first installed there in a commercial dairy plant in 1952 is now making a bid for recognition in this country. It seeks to lower packaging costs by forming and filling a unique tetrahedral container in a single operation. The sales campaign for the new four-sided package is aimed at the mass feeding market, particularly the schools, where the problem of educating the consumer to buy his milk in a container of unorthodox shape is not as important as convincing the operator of a mass feeding facility that he can save money by using the new container.

This same mass feeding market already is the focal point of a contest between suppliers of bulk milk dispensers and suppliers of conventional glass and paper containers. Although the dispenser can is not a new development, its introduction into schools is comparatively recent.

1/ Mr. Enger transferred from the Department before completion of this report.

This study was undertaken to determine the comparative advantages and disadvantages of new and conventional containers used to supply milk to schools. Labor requirements and costs were an important phase of the study.

Background 2/

The first Swedish machine to reach this country was installed on an experimental basis in a New Jersey dairy in 1955. 3/ The next machines were obtained the following year by the Dairy Industry Department of Cornell University, primarily for the study of the sanitary and engineering aspects of the equipment and the packages. A number of the machine's features did not conform with the rigid sanitation standards generally enforced in this country. These features were redesigned and the modifications were incorporated into the machines.

One feature of the package provided an exceptionally thorny problem. There is no pouring lip. The surface of the container is unbroken until one of the corners is torn or cut off to permit the milk to be poured. The Milk Ordinance and Code of the Public Health Service assumes that containers have pouring lips and provides instructions for covering and protecting them from contamination during handling and storage. The Public Health Service reserved judgment on the new container pending determination of how well it protected milk within it.

At the request of the manufacturer, the container was subjected to a series of bacteriological tests at Cornell. The researchers concluded: "While (it) does not have a covered pouring lip in the strict sense, the pouring orifice does have an edge of freshly uncovered resin, an edge which is not readily wetted and which gives a clean, uncontaminated stream under conditions where other materials might fail. The effluent liquid does not touch the outer package surface. The freedom from contamination in (our) tests indicates that it is difficult to contaminate good milk packaged in this container." 4/

The Public Health Service submitted the bacteriological report to a panel of consultants for study and appraisal. The panel voted to recognize the container "as being satisfactory for use in packaging milk and milk products."

2/ Findlen, P. J., and Holland, R. F. Tetra Pak for Dairy Products, A Survey of European Experience. Publication of Cornell Univ., 40 pp., April 1956.

3/ At conventions of the Milk Industry Foundation, in Atlantic City in 1956 and Chicago in 1958, U. S. pioneers in the commercial use of the new machine described their experiences with enthusiasm to attentive audiences. The speakers were Bo Adlerberg of Hillside, N. J., G. L. McFarland, Jr., of Indianapolis, Ind., and W. A. Josephson of Anniston, Ala.

4/ Holland, R. F., and White, J. C. (Dept. Dairy Indus., Cornell Univ.) A Study of the Bacteriological Properties of the Tetra Pak Milk Container. A report reproduced by Milk and Food Program, Dept. Health, Education, and Welfare, Washington, D. C., July 1958.

Accordingly PHS in November 1958 advised interested State and local health authorities that the container would comply with the recommended Milk Ordinance and Code provided the following conditions are met:

"(1) The filling and sealing equipment is modified in the same manner as that at Cornell; (2) the container is fabricated from paper stock which complies with Code requirements; and (3) the Plastic coating and bonding material is, as stated by suppliers to be the case, polyethylene of a type acceptable to the Food and Drug Administration for food packaging, and fromm from toxic additives."

METHODS OF STUDY

When this research was started, a machine to form and fill the new Swedish containers had been installed in but one commercial dairy in this country. Therefore, the case study method was adopted, starting in the first plant. As new installations were made the studies were extended.

In four plants in different cities, researchers made a comparative evaluation of the new type half-pint container and conventional machine-filled containers used to deliver milk to schools. In four other plants, 5-gallon dispenser cans were compared with conventional machine-filled half-pint containers. Two of these plants were affiliated and data received from them were combined in a single case study.

Operational practices, marketing problems, and the advantages and disadventages of the various containers were discussed with owners or managers, and plant personnel. Costs were obtained. The handling and processing of container materials and containers were observed at every stage from the time of arrival at the receiving dock, through storage, the filling room, the refrigerator, and delivery truck, and to the serving at the schools.

The amount of direct labor used in every major operation was determined in terms of man-minutes per 1,000 half pints of milk packaged. In machine filling and closely related operations linked by an integrated conveyor system, this time was governed by the observed operating speed of the filling machine. When a worker performed more than one duty, his time devoted to a specific container operation was determined by a time study. Overall time to set up, clean, and maintain the filling equipment was spread over the observed daily output.

The labor time reported in the case studies is essentially the actual time used and not standard time requirements, thus no allowance was made for fatigue or personal needs. It was noted that when a worker was paced by a machine he learned to maintain the pace and to satisfy his needs without interrupting production. Operation schedules imposed no undue burdens.

Time studies likewise were conducted on all operations in filling and handling dispenser cans. Although mechanical washers and semi-automatic fillers for cans were observed, the overall operation was primarily manual in all plants visited.

Researchers observed and timed the delivery of more than 30,000 half pints of milk in 75 schools. Handling the milk in the schools and serving the milk to the children also was observed to determine the relative suitability of the different containers. School system supervisors, principals, teachers, cafeteria managers, and workers were interviewed.

Labor requirements for the filling and handling operations, as well as costs of materials, containers, and equipment are detailed plant by plant in order to bring out differences resulting from various levels of production and different operating procedures. Space, storage, and utility requirements, and other factors influencing container suitability are discussed in general terms following the individual case studies. Because of the similarity of the delivery and serving patterns observed, this phase of the study also is consolidated.

Researchers computed two sets of comparative costs of washing and filling equipment per unit of output, one at the observed case study level of output and one at an assumed level shown at the conclusion of the case studies.

At each of the four dairies where the new tetrahedral container was evaluated, the filling equipment had only recently been installed at the time of the study. There had been little opportunity to push sales. In each dairy visited the tetra machine, limited to half pints, was used almost entirely for putting out school milk orders. The machines operated from less than an hour to a little more than 2 hours a day, 5 days a week during the school year, about 180 days. Most of the more versatile conventional machines, with which the tetra was compared, worked on half pints, pints, and quarts for general distribution from 6 hours upwards daily about 310 days a year.

Under these circumstances, conventional machines cost much less per unit of output. However, all dairies equipped with the new machine were making efforts to build up their half-pint tetra business to take advantage of unused filler capacity. Therefore, tetra machine costs were computed not only at observed output levels but also at higher assumed levels of both part-of-the-year school business and all-year general business.

As noted above, most of the conventional machines were in an operating status a minimum of 6 hours daily. Assuming that 10 percent of this time was devoted to changing product or container size, or making minor adjustments, the conventional machines were packaging milk at least 5 hours and 24 minutes a day. If the new tetra machine were operated on this schedule it would fill about 24,000 containers a day. This was the level selected for the adjusted cost comparison.

The conventional machines observed operated at speeds between 20 and 90 containers per minute. The selected level of 24,000 containers a day was beyond a reasonable daily output for the smaller machines. Therefore, only the larger and faster conventional machines were included in the adjusted cost comparisons which follow the case studies.

Some filling machines were leased and some were sold outright under extremely diverse methods of payment. The tetra machine may be leased under either of two agreements. Under one--which is comparatively new--the bulk of the base rental is paid off within 60 days of installation; under the other these payments are stretched over 40 months, and under both there is a quarterly rental which continues through the life of the machine. All dairies visited were paying under the 40-month plan. In addition to the base rental, a production rental is charged on a sliding scale which declines on a unit basis as the total volume of container output increases. Two of the three principal suppliers of conventional paper filling machines also charge a production rental. The total purchase price or the total base and production rental, including the quarterly rental, is spread over a 10-year period and charged to each 1,000 units of output. No interest is charged against machine cost. In all transactions studied, the dairies made almost all payments from working capital.

LIMITATIONS OF STUDY

This study included only conventional containers in general use in schools and containers introduced comparatively recently in schools. The conventional containers studied were paper and glass half pints. Pint, quart, half-gallon, and gallon containers were not included.

Although glass half-pint bottles may vary somewhat from maker to maker, particularly in shape, no fundamental differences were observed. Variations among bottle caps and hoods were more apparent. However, with only a limited number of case studies to cover all general types of containers, the effects of variations among caps were not appraised.

Only major direct costs and labor requirements were determined. Joint costs usually were not allocated specifically.

As previously indicated, some labor requirements per unit of output were computed on the basis of the normal operating speed of the filling machines. Although the machines frequently were shut down to change the product or the size of the container, or for adjustments or repairs, the individual studies were not considered to be of sufficient duration to permit assignment of a fair efficiency rating to any one machine.

Three of the four tetra machines studied were equipped with an automatic packout device, a great labor saver. None of the conventional machines with which the tetra was compared were similarly equipped. Dispenser cans were compared only with conventional paper containers, not with bottles.

The plants where these case studies were made were not necessarily representative of all dairy plants. They were selected because they were equipped to fill both new and conventional containers used for the delivery of milk to schools.

DESCRIPTION OF CONTAINERS

Conventional Containers

Glass Bottles

The glass bottle is the oldest of our conventional containers in which milk is distributed. Although there are variations, the typical half-pint bottle observed in this study was 5½ inches tall and was square, the side being 2-3/16 inches wide. Corners and edges were rounded. A considerable variety of caps and hoods was available. The caps observed were of crimped aluminum lined with paper.

Twenty-four bottles were packed in a single-layer wood case with metal dividers. Outside dimensions were 15-1/8 by 12-1/8 by 7-3/8 inches. (A case holding 20 bottles of a slightly different shape also was noted.) Vertical metal corner strips extended slightly higher than the side walls and fit around the corners of the case above to improve stacking ability.

New half-pint bottles were delivered from the factories to the dairies in compact paper-wrapped packages of six dozen units. One such package measured 16 by 13½ by 11½ inches.

Gable-Top Paper Carton

This is the most widely used paper container. It is delivered to the dairy in the form of a one-piece flat, or blank--1,000 to a fiberboard box measuring 16 by 13 by 11-3/4 inches.

On a machine in the dairy the flat is squared up; the bottom flaps are glued; the open container is dipped in liquid wax, drained, chilled, and filled with milk; and the top edges are drawn together to form a gable, folded over and stapled shut. The half-pint container is 2-7/8 inches square and 3½ inches high. Of the total height, 1-7/8 inches is in the square body and 1-5/8 inches in the gable.

The containers, when filled, were packed 48 to 66 per case of wood or metal.

Flat-Top Paper Carton

This container is completely made up at the factory and ready to go on the filling machine when it is received at the dairy; 693 half-pint containers are delivered in an easily handled, paper-wrapped package, 26 by 20½ by 24½ inches. The half-pint carton is 3½ inches tall with square bottom and top 2¼

inches to the side. The top is flat, the corners are rounded. The paperboard is lightly and evenly waxed inside and out. There is a round opening in one corner of the top, closed by a hinged paper plug with a flange which protects the pouring lip. After filling, these cartons are packed 60 to a case in two layers of 30. A paper pad may be placed under the bottom layer and over the top layer in the case. The wood case is 16½ by 13¼ by 11 inches. Metal cases also may be used.

Recessed-Top Paper Carton

This container, which is coated with a vinyl plastic, is delivered to the dairy knocked down in three component parts: sidewalls, bottoms, and tops. A machine in the dairy squares up and seals the sidewalls, seals the bottom to the sidewalls, fills the open container, and seals the top to the sidewalls. The completed half-pint container is almost a cube 2-5/8 inches tall and square with 2-7/8 inches to the side. The top is recessed ¼ inch. The filled containers were packed 60 to a wood case, in 3 layers of 20 each. The case was 16-3/4 by 12-3/4 by 10½ inches. Metal cases also may be used.

Experimental Containers

New Swedish Tetra Container

This is a radical departure from the usual concept of a container. In shape it is a tetrahedron, a kind of lopsided pyramid with four triangular plane surfaces. It often is referred to as a "tetra" container (fig. 1, left). A puzzled dairyman, seeing it for the first time, asked: "Which side is the bottom?" "Which ever side it happens to be sitting on," was the answer. There is no top side when the container is "sitting," only a peak in the air where the three sides join at a point off center.

The dairy now receives the container paper in rolls long enough to make 7,500 half-pint units. (Formerly the number of containers per roll varied considerably.) The packaged roll as delivered is about 21½ by 21½ by 9½ inches. No other material is required.

Milk is almost literally wrapped in the bleached kraft paper which has a bonded layer of polyethylene on the inner surface and a light coating of wax on the outside. A roll of paper is attached to a reel.

The filling machine pulls the paper steadily from the reel, draws it into the shape of a tube, and seals it continuously along a longitudinal seam. Horizontal heated jaws press across the tube of paper to make a transverse seam. Milk flows into the tube at a rate that maintains a constant level--although the seal closing the bottom of the tube is moving steadily down and away.

A second set of horizontal jaws, at right angles to the first set, moves across the filled section of the tube, sealing the tube and completing the

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Figure 1.--At left, demonstrator drinks milk from the new tetra container. A corner has been removed to permit insertion of the straw. Young lady at right holds paper tube from which the containers are made. A machine forms the four-sided packages from the milk-filled tube which is heat sealed alternately from front to back and from left to right.

"wrapping" of the package of milk. This same seal, which constitutes the top of one container, becomes the bottom of the next container formed from the tube.

The tube, sealed at regular intervals, becomes a kind of chain of 4-sided packages--different in shape but comparable to a string of sausage links (fig. 1, right). The chain moves through a cutter which snips off each container as it comes along.

The containers are packed automatically into a 6-sided metal case, in 3 layers of 6 containers each for a total of 18. The containers are dropped into each layer with points to the center like cuts of a pie. The case is 7-3/8 inches high, and measures 10-3/8 inches between opposite sides and 12 inches between opposite corners. The cases nest when empty.

To open the tetra container, a notched corner is torn off. This allows the container to relax and bulge slightly due to the contained liquid pressure. The bulging permits the level of the liquid in the container to fall below the corner opening, thus preventing spilling.

Dispenser Cans

All the dispenser cans observed in schools were the 5-gallon size. They were made of steel with a coating of tin inside and outside. When the coating is chipped off by rough handling the cans are re-tinned. (No stainless steel cans were observed.)

The cans are about 10½ inches in diameter and 20 to 22 inches tall. The can covers are of the umbrella type; they extend out beyond the rim of the neck to protect it from contamination. The covers fit tightly into the neck which usually is about 7¼ inches in diameter. There are two or three holes in the cover rims for the insertion of wire seals to prevent opening of the can before use. Each can has two sturdy handles, one opposite the other on the shoulder of the can.

Milk is drawn from a spout on the bottom of the can. Before every filling, the open end of a plastic covered flexible tube is fitted over this spout. The other end of the tube is solid, with no opening, to prevent escape of the milk until the can is placed in the dispenser unit and the tube is pulled through a squeeze valve. When it is time to serve the milk, the solid end of the tube is cut off. The cans are designed to fit into dispenser units at the point of serving (fig. 2).

CASE STUDY EVALUATION OF CONTAINERS IN DAIRY PLANTS

In each of four dairies researchers made a case study evaluating the new Swedish half-pint tetra container in comparison with one or more conventional machine-filled half-pint containers used in delivery of milk to schools. Glass bottles were observed in two plants and gable-top paper containers in three plants.

In three other plants the researchers compared 5-gallon dispenser cans with (1) the gable-top containers, (2) factory-made flat-top paper containers, and (3) vinyl plastic-coated recessed-top paper containers. In an eighth plant, an affiliate of one of the three just mentioned, the conventional half-pint container was the same as that in the parent plant and the packaging operation was very similar. The can operation, however, was quite different. Therefore, the parent plant and the affiliate were combined in a single case study of a conventional half-pint container compared with dispenser cans filled on two separate lines.

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Figure 2.--Delivery man has just placed a fresh can of milk in a school dispenser unit and is preparing to fit the tube into a squeeze valve which controls the flow of milk. Cafeteria manager is filling glasses which will be set out at tables for children too young to serve themselves.

Case Study 1. - Tetra and Bottles

The first case study was made in a small independent dairy with wholesale and retail routes and a good school business. Most of the milk was bottled in glass. A few schools, cafeterias, and stores were supplied with milk packaged in tetrahedral half-pint containers.

The dairy had a glass-filling machine with a speed of 90 half-pint bottles a minute, a bottle washer, and a case washer served by a conveyor system. The tetrahedral filling machine, the first installed in this country, formed and filled 72 containers a minute. It was not equipped with an automatic packout and it was not served by a conveyor.

Cost of Materials

The cost of materials for the half-pint bottles and tetrahedral containers are listed in table 1. The cost listed for the bottles, themselves, is relatively high because of their low trippage (11.9), or high rate of disappearance. Although the low trippage was attributed to customers other than the schools, the plant bookkeeping methods were such that school records could not be separated out. Heaviest losses were suffered in supplying milk to lunchrooms which permitted customers to take out orders of coffee in empty half-pint milk bottles. The cost of the cases for both containers was based on a 4-year estimated life.

Table 1.--Materials costs per 1,000 half-pint units, case study 1

Item	Glass bottles	Tetra containers
	Dollars	Dollars
Bottles	4.80	---
Caps	1.98	---
Paper	---	5.47
Cases	0.65	0.48
Total	7.43	5.95

Machine Ownership Cost

This plant operated its glass washer and bottler 365 days a year. At the observed level of output of 24,000 units a day the machine ownership cost was 35 cents per 1,000 units of production.

When this case study was made the tetrahedral machine was operating nearly on an experimental basis and the output was both small and irregular. Therefore, the highest day's output observed--an hour's run of about 4,300 units--was considered as the usual output rather than the average of all daily outputs observed. Furthermore, it was assumed that half the volume went to schools 180 days a year, and the other half to wholesale outlets the year around.

On this basis, the basic machine ownership cost was computed at $2.03 per 1,000 half pints plus a production rental of $1.10 per 1,000.

Labor Requirements

One full-time worker was assigned to the bottle washer, and another to operate the glass filler and to case out the bottles. Supplying empty cases, and stacking full cases of bottles in the refrigerator were part-time jobs.

The time listed in table 2 for washing bottles and cases is unusually high because most of the bottles returning to the plant from schools could not

be fed directly into the automatic washer. At the schools, the bottle caps (crimped aluminum lined with paper were left in place and pierced to admit a straw. The children, after drinking their milk, usually left the straw in tl bottle. Often they enlarged the hole in the cap and poked in used paper nap kins and other trash. At the dairy plant a large amount of hand labor was re quired to remove the caps and the trash from the bottles before sending them to the washer.

Two men were needed to operate the tetrahedral filling machine and case out the half-pint containers. Because of the sloping surfaces of the containers, it was quite difficult to pick them up quickly as they fell from the machine and to fit them into the hexagonal carriers. Stacks of empty cases were wheeled in to the machine and full cases were moved to the refrigerator by a workman with a handtruck. This worker frequently stood idle waiting for the machine men to complete a full stack. Inasmuch as this was more nearly a pilot operation than a commercial operation, the unproductive waiting time is not listed in table 2.

Table 2.--Direct labor requirements to fill and handle 1,000 half-pint units of milk, case study 1

Item	Glass bottles	Tetra containers
	Man-minutes	Man-minutes
Set up machine	1.25	1/3.28
Wash bottles and cases	2/58.35	2.03
Supply empty cases	1.00	4.46
Fill and case	11.15	29.50
Store in refrigerator	3.68	4.97
Clean and maintain equipment	3.76	1/6.26
Total	79.19	50.30

1/ Total time charged to one hour's output of 4,300 containers.
2/ Includes 43.62 minutes to remove caps and trash from bottles.

Combined Costs

The total container, machine ownership, and labor costs per 1,000 units of output were $10.69 for the glass bottles and $10.93 for the tetra containers (table 3).

Table 3.--Container materials, machine ownership, and direct labor costs to fill and handle 1,000 half pints, case study 1

Item	Glass bottles	Tetra containers
	Dollars	Dollars
Containers	7.43	5.95
Machine ownership	.35	3.13
Labor ($2.20 per hour)	2.91	1.85
Total	10.69	10.93

Case Study 2.--Tetra, Bottles, and Small Gable-Top Operation

This study was made in a small family-owned dairy that specialized in top quality milk, much of it from its own herd. It handled about 3,200 gallons of milk daily; about 15,000 half pints (more than 900 gallons) were distributed in the school milk program.

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Figure 3.--On this compact machine the new tetra containers were formed, filled, and automatically packed into cases. Automatic caser is at right.

The dairy used three different types of containers in its filling room: glass bottles, gable-top paper cartons, and tetrahedral paper containers. Most of the school milk was distributed in tetrahedral containers. The glass-filling machine had a speed of 66 half-pint bottles per minute, a small gable-top machine filled 20 half pints per minute, and the tetrahedral machine, equipped with an automatic caser, put out 75 containers per minute (fig. 3). The daily output was 9,000 tetra half-pint containers, 5,600 glass half pints to quarts, and 5,200 gable-top half pints to quarts.

This dairy occupied a new plant. The filling room was large and uncluttered. There was no conveyor system. For the two conventional machines, empty cases were rolled in and full cases moved out to refrigeration on dollies. Two single stacks were loaded on each dolly, cases of 20 half-pint bottles went 8 high, and cases of 48 gable-top half pints, 5 or 6 high. Full cases of 18 tetra half pints were stacked 10 high and hand-trucked to the cooler. Stacks of empty tetra cases were nested 20 high and trucked to a ready station beside

the filling machine. The truck wheels were rubber-tired and the tetra cases were moved rapidly. The dollies were mounted on casters and the wheels swiveled unsteadily unless the load was pushed with care.

Costs of Materials

Materials costs are listed in table 4. The relatively low cost of the bottles is due to the fact that the dairy's bottle trippage was high (35) and the bottles were purchased secondhand.

Table 4.--Materials cost per 1,000 half-pint units, case study 2

Item	Glass bottles	Gable-top containers	Tetra containers
	Dollars	Dollars	Dollars
Bottles	1.14	---	---
Caps	2.18	---	---
Paper	---	7.11	5.48
Wax	---	1.98	---
Wire	---	0.06	---
Glue	---	0.16	---
Cases	0.58	0.19	0.30
Total	3.90	9.50	5.78

Machine Ownership Cost

This plant packaged milk every day except Sunday, or about 310 days a year. At the observed level of output the ownership cost of the washer and bottler was 94 cents per 1,000 units of production.

Cost of the conventional paper-filling machine was about 67 cents per 1,000 units plus $1 per 1,000 production rental.

The tetrahedral machine was used exclusively in packaging milk for delivery to schools. With the entire annual charge absorbed by only 180 days of production, the base machine cost was $1.58 per 1,000 half pints, plus $1 per 1,000 production rental.

Labor Requirements

One man operated each filling machine and also packed out the full containers. At the tetra machine, the operator about every 15 seconds merely removed a full case of 18 half pints from a newly developed automatic packout attachment and replaced it with an empty case (fig. 4). The bottle washer also required a full-time operator.

BN-9300

Figure 4.--The machine operator removes a full case of 18 tetra containers from automatic packout device. Just above the partially filled case in the center, a half-pint container may be seen about to fall into place.

Supplying empty tetra cases, and moving full tetra cases to the refrigerator and storing them was a part-time job. The handyman who serviced the machines wasted no time waiting for a full stack of cases to be completed. Usually he could see from his other work stations when he was needed. If he had work outside the filling room he returned when he could. If more than one stack was waiting he took them in turn. This was the fastest tetra case supply and storage operation observed. Because the cases were stacked as part of the filling operation, there was no need to stack them again when they reached the refrigerator.

Although it only needed one man, labor requirements for the gable-top filling operation were relatively high because the machine was a small model and its rate of output was slow.

Most of the bottle caps and straws were removed at the schools. Drivers of the delivery trucks removed the few caps that did remain on the bottles. When the bottles returned to the plant they were ready to go to the washer. One man with occasional help operated the bottle washer. Labor requirements are itemized in table 5.

Table 5.--Direct labor requirements to fill and handle 1,000 half-pint units of milk, case study 2

Item	Glass bottles	Gable-top container	Tetra container
	Man-minutes	Man-minutes	Man-minutes
Set up machine	2.03	7.51	1.29
Wash bottles	1/20.83	---	---
Supply empty cases	3.29	1.56	2.49
Fill and case	15.12	51.30	13.46
Store in refrigerator	2.57	1.75	2.09
Clean and maintain equipment	4.21	6.54	2.71
Total	48.05	68.66	22.04

1/ Does not include 6.10 man-minutes required of routemen to remove caps and straws from bottles picked up at schools.

Combined Direct Costs

The total cost of containers, machine ownership, and direct labor per 1,000 half pints of output was $6.21 for glass bottles, $13.13 for gable-top containers, and $8.99 for tetra containers (table 6).

Table 6.--Container materials, machine ownership and direct labor cost to fill and handle 1,000 half-pint units, case study 2

Item	Glass bottles	Gable-top containers	Tetra containers
	Dollars	Dollars	Dollars
Container	3.90	9.50	5.78
Machine	.94	1.67	2.58
Labor ($1.71 per hour)	1.37	1.96	.63
Total	6.21	13.13	8.99

Case Study 3.--Tetra and Medium Gable-Top Operation

The plant selected for this study had a fluid milk output of more than 4,000 gallons daily and also had a good ice cream business. It operated 5 days a week and made deliveries 6 days.

Most of the milk was packaged by two gable-top machines, one adjustable to sizes from half pints to quarts, and the other only for half gallons. The adjustable machine put out about 11,000 units daily for general use at a rate

of 32 per minute. Conveyors from the two machines converged and moved full containers to packing stations inside the refrigerator room. Most of the school milk was packaged on a new tetra machine at a rate of 75 half pints per minute. The regular school business amounted to about 12,000 half pints daily, in a 30-mile radius from the dairy.

The tetra machine was not tied in with the existing conveyor system. Instead, a specially designed overhead conveyor was installed at a cost of $2,300. It consisted of a motor-driven endless chain with hooks on which carrier cases were hung (fig. 5). The conveyor circled from the case washing machine, to the tetra filling machine, to the refrigerator room and on back to the case washer. The speed of the conveyor was so regulated that an empty case arrived at the filler about every 15 seconds--the time required to fill one case of 18 half pints.

BN-9302

Figure 5.--The operator of filling machine hitches full case of tetra containers to ingenious overhead conveyor which will carry them to refrigerator.

Cost of Materials

The tetra machine needed only specially coated paper while the gable-top machine required container blanks, glue, wire, and wax.

In this dairy the carrier cases for the gable-top containers were of wood and had an expected useful life of 3 years. The carrier cases for the tetrahedral containers were of galvanized metal and had an expected useful life of 4 years. The wooden carrier cases held 50 half-pint cartons and the metal cases held 18 tetra containers. Table 7 gives a breakdown of materials costs.

Table 7.--Materials cost per 1,000 units of half-pint containers, case study 3

Item	Gable-top containers	Tetra containers
	Dollars	Dollars
Containers	6.85	5.85
Wax	1.98	---
Wire	0.07	---
Glue	0.16	---
Carrier cases	0.20	0.49
Total	9.26	6.34

Machine Ownership Cost

This plant operated its conventional paper-filling machine 5 days a week the year around. At the level of output observed the machine cost was computed at 60 cents per 1,000 units of production plus a production rental of $1 per thousand.

The tetrahedral container filler packaged only milk for delivery to schools. At the production level required by contracts in force the machine cost was $1.32 per 1,000 half pints plus production rental of 95 cents per 1,000.

Labor Requirements

One man operated the two gable-top machines. Two workers just inside the refrigerator, one for each machine, packed the full cartons into cases.

One man operated the tetra filling machine. About every 15 seconds he removed a full case from the automatic packout device, suspended it on a pair of conveyor hooks, reached for an empty case on the next pair of hooks, and fitted the empty case into the automatic packout.

This workman was not a skilled machine operator. When not assigned to the tetra machine, he performed various jobs. He routinely set up the machine and washed up at the end of the run. However, the skilled operator of the two gable-top machines assisted with the setup and frequently during the filling, stepped over to make minor adjustments or to check the machine temperature.

In the refrigerator, the worker who packed out the half-gallon containers reached up and lifted down full tetra cases as they passed very nearly overhead, and stacked them at his side.

One full-time workman in the refrigerator moved stacks of packaged milk from all three machines to assigned storage locations, and made up orders to be loaded in delivery trucks. It took the same length of time to move a stack of either type of container, but a stack of 7 cases of gable tops contained 350 half pints whereas a stack of 11 cases of tetras contained 198 half pints. Therefore, direct labor required on an equivalent unit basis was less for the gable tops.

One workman washed and supplied empty cases for all three machines. Labor requirements are listed in table 8.

Table 8.--Labor requirements to fill and handle 1,000 half pints, case study 3

Item	Gable-top containers	Tetra containers
	Man-minutes	Man-minutes
Set up machine	3.00	2.50
Supply empty cases	10.41	4.44
Fill and case	46.88	13.33
Store in refrigerator	1.44	1/6.08
Clean up and maintain equipment	6.00	5.00
Total	67.73	31.35

1/ Includes 4.06 man-minutes to remove full cases from conveyor and to stack them, and 2.02 man-minutes to handtruck cases to storage area.

Combined Costs

Total container materials, machine ownership, and direct labor costs were $12.91 per 1,000 half pints for the gable-top and $9.56 for the tetra containers (table 9).

Table 9.--Combined container materials, machine ownership, and direct labor costs per 1,000 half-pint units, case study 3

Item	Gable-top containers	Tetra containers
	Dollars	Dollars
Container materials	9.26	6.34
Machine ownership	1.60	2.27
Direct labor ($1.82 per hour) 1/	2.05	.95
Total	12.91	9.56

1/ Includes annual bonus.

Case Study 4.--Tetra and Large Gable-Top Operation

This study was conducted in a large dairy plant that handled 14,000 gallons of milk per day.

The dairy attempted to integrate its tetra machine into the overall production operation. The machine utilized the existing conveyor system without any additional new handling equipment and with only minor alterations.

The dairy had three conventional filling machines; two put up milk in half-pint, pint, and quart gable-top containers, and one filled half-gallon containers. The first two machines, which had an output of 65 containers per minute, each filled about 25,000 units per day, about half of which were half pints.

The tetra machine filled approximately 8,000 half pints daily for the school milk program at a rate of 75 per minute. Occasionally, it also put out small orders of an orange drink.

A workman on the unloading platform stacked 5 empty cases for the tetra into an empty gable-top carrier case and placed all on a conveyor which carried them through the case washer and into the filling room. There, the operator of the tetra machine removed the tetra cases from the conveyor, and stacked them beside the machine. The now empty gable-top case continued on its way to the gable-top machines. A second conveyor, passing by all the filling machines, moved the full cases to the cold storage room.

Cost of Materials

Prices of materials for the containers were comparatively low because the dairy purchased in large volumes.

Both types of containers were packed in galvanized metal carrier cases and both cases were estimated to have a life of 4 years. From records it was determined that the dairy had to have an inventory of four times the daily requirement of cases. Table 10 lists the costs of the materials.

Table 10.--Container materials cost per 1,000 half-pint units, case study 4

Item	Gable-top container	Tetra container
	Dollars	Dollars
Paper	6.54	5.40
Wax	1.79	---
Wire	0.05	---
Glue	0.13	---
Carrier cases	0.16	0.36
Total	8.67	5.76

Machine Ownership Cost

This plant packaged milk on its conventional paper filling machine 6 days a week during the entire year. At the observed level of output the machine ownership cost was computed at 34 cents per 1,000 plus a production rental of 85 cents per 1,000.

The tetra machine was used almost exclusively to package school milk 180 days a year. Occasionally it put out a very limited run of an orange drink. Computed on the basis of the school milk business only, the machine ownership cost was $1.82 per 1,000 half pints plus production rental of $1 per 1,000.

Labor Requirements

One man operated the case washer. When all four filling machines were in operation he had a full-time job selecting the proper cases from nearby stacks and pushing them into the washer. When one or more of the machines were idle this worker consolidated scattered stacks of empty cases or helped drivers unload empty cases from returning trucks.

In the filling room there was an operator and a packout man for each gable-top machine. One man set up and operated the tetra machine. Most of his time was given to feeding empty cases to the automatic packout, removing full cases and placing them on the conveyor.

During most of the day two men removed cases of conventional containers from the conveyor and stacked them in their assigned places in the cold storage room. During the comparatively short time the tetra machine was in operation, one man handled all the milk from this machine and the other all the milk from the three conventional machines. The tetra containers were being stowed some distance from the stacking area of the conventional containers being received at the same time. A small case of 18 tetra containers arrived at its storage area about every 15 seconds. Thus the workman did not have time between cases to move to the other location and help stack cases of conventional containers. This division of labor resulted in an unbalance of the workload and a relatively inefficient use of manpower in the tetra operation. In addition to stacking incoming cases, both men sometimes helped assemble orders for the delivery trucks.

Although it required more actual time to clean the gable-top machine than the tetra, the gable-top cleaning time was shorter on a unit basis because total time could be charged to a larger volume of production resulting from more hours of machine operation. Comparative labor requirements are listed in table 11.

Table 11.--Direct labor requirements to fill and handle 1,000 half-pint units, case study 4

Labor item	Gable-top carton	Tetra container
	Man-minutes	Man-minutes
Set up machine	1.25	3.75
Supply empty cases	3.90	3.33
Fill and case	31.24	13.33
Stack in refrigerator	5.21	13.33
Clean up and maintain equipment	5.00	7.50
Total	46.60	41.24

Combined Costs

The total materials, machine ownership, and direct labor costs within the plant per 1,000 half pints packaged were $11.17 for the gable-top and $9.74 for the tetra (table 12).

Table 12.--Combined container materials, machine ownership, and direct labor cost to fill and handle 1,000 half-pint units, case study 4

Item	Gable-top carton	Tetra container
	Dollars	Dollars
Container materials	8.67	5.76
Machine ownership	1.19	2.82
Direct labor ($1.69/hr.) 1/	1.31	1.16
Total	11.17	9.74

1/ Includes fringe benefits.

Case Study 5.--Dispenser Cans and Recessed-Top Cartons

This study was made in a large independent, family-owned dairy which had been enlarged and rebuilt many times since its founding early in the century. It handled about 20,000 gallons a day; most was distributed as whole fluid milk and the rest was processed as ice cream, skim milk, and cheese.

Most of the fluid milk was packaged in plastic-coated paper containers with recessed tops which were filled by a battery of four machines lined up side by side. Each machine operated at a speed of about 64 containers per minute and could be adjusted to fill half pints, pints, quarts, and twin quarts. Usually, one machine filled about 30,000 half-pint containers per day, most of them for delivery to schools.

There also was a glass operation which was not included in this study. Both the paper and the glass fillers were served by an efficient conveyor system with a number of mechanical control features, and by two automatic case stackers. The conveyor was so routed through the large refrigerator room that no storage area was more than a few steps away from it.

This plant filled from 80 to 120 5-gallon dispenser cans daily. A smaller affiliated plant served 2 school systems with about 40 dispenser cans daily. The can operation was studied in both plants. In both, the operation was primarily manual.

Materials Costs

Materials costs for the recessed-top container per 1,000 half pints were as follows:

Item	Dollars
Sidewalls ..	4.09
Tops	2.27
Bottoms	1.67
Foil	.47
Total .	8.50

At the time this study was made, freight charges amounted to an additional 42 cents. However, negotiations were in progress to reduce this charge.

Container and materials costs per 1,000 half pints (12.5 cans) filled at the main plant were as follows:

Item	Dollars
Tubes	.48
Tube closures	.20
Seals	.20
Tags	.06
Parchment	.04
Cans	2.39
Total	3.37

The cost of the cans was based on a one-year life and one re-tinning.

Costs at the affiliated plant totaled $1.97 because the cans were reported to last twice as long and they were not the type that required closures to cover the tubes.

Machine Ownership Costs

Ownership cost of the machine that formed and filled the recessed-top paper containers was 62 cents per 1,000 half pints and a production payment of 89 cents per 1,000 containers.

The only machinery which could be charged directly to the can operation at the main plant was a semi-automatic filler. The ownership cost over a 10-year life was estimated at 5 cents per 1,000 half pints filled.

The affiliated plant employed a filler, a converted bulk can washer and a hand washing vat. Ownership costs per 1,000 half pints filled were estimated at 35 cents.

Labor Requirements

One worker pulled empty cases from stacks in a storage room and fed them to a conveyor leading to all four paper packaging machines. One man operated each filling machine and a second packed the full containers into cases.

When five full cases had accumulated on a conveyor spur, they were admitted to the main conveyor line. Just inside the refrigerator the cases were automatically stacked five high and released to move again along the main line of the conveyor. One of the two men regularly on duty in the refrigerator usually worked near the stacker, and the other farther along the conveyor. When the stack moving along the conveyor reached the nearest point to its storage area, one of the workmen slipped a hook into the handhole of the bottom crate and skidded the entire stack into its allotted place.

Direct labor requirements per 1,000 half pints to fill and handle the recessed-top paper containers were as follows:

Labor item	Man-minutes
Set up machine	2.40
Supply empty cases	3.90
Fill and case	31.24
Store in refrigerator	1.03
Clean and maintain equipment	4.64
Total	43.21

In the dispenser can operations at the main plant one man removed dirty cans from the incoming conveyor, knocked off the cover, and stripped off parchment lining and old dispenser tube. He then scrubbed and rinsed cans and covers, replaced the covers and stacked the clean cans two high near a door to the filler room.

A second worker loaded from 20 to 40 cans on a 4-wheel cart and hauled them into the filling area. There he attached clean tubes to the dispenser spouts, rinsed all cans with an antiseptic solution, positioned the cans on a semi-automatic filler, placed clean parchment over the mouth of full cans, fitted on the tops and affixed three seals to each can. As the cans were sealed they were heaved up on a roller conveyor which took them into the refrigerator. In the refrigerator they were stored two-high.

Time required to fill and handle 1,000 half pints (12.5 cans) was as follows in the main plant:

Operation	Man-minutes
Set up equipment	1.50
Strip and wash cans	23.75
Move to filling area	3.49
Prepare tubes and materials	1.84
Attach tube and apply closure	5.91
Remove covers and rinse	2.58
Fill can, insert parchment, and cover	5.85
Seal and tag	8.32
Move to refrigerator and stack	2.48
Clean and maintain equipment	2.25
Total	57.97

In the affiliated plant, cans from returning delivery trucks were dumped in an outdoor courtyard where they were stripped of old tubes and parchment, stacked on a handcart and hauled half way around the building to a conveyor which led to a bulk can washing machine.

Two men working together took over at the washing machine; one removed covers and placed cans and covers into the washing machine, the other removed cans and covers from the other end of the machine and stacked them. After the machine wash, the cans were carried to a wash vat where they were hand-scrubbed and rinsed. New dispenser tubes were attached and the cans were positioned on the filler. Full cans were loaded on a handcart and hauled to an open area just outside the refrigerator door. Here a third worker joined the operation to assist in the final step of attaching lead and wire seals and carrying the completed cans, two by two, into the refrigerator.

Time required to fill and handle 1,000 half pints (12.5 cans) in the subsidiary plant was as follows:

Operation	Man-minutes
Set up equipment	2.00
Strip seals, parchment and tubes	3.75
Move to washer	2.38
Wash (machine plus hand)	15.88
Prepare, dip, cut, and attach tubes ...	4.81
Move to filler	2.38
Remove covers, prepare rinse, rinse, fill, place parchment, cover, and move to refrigerator door............	9.93
Seal and tag	7.20
Move into refrigerator and stack	2.38
Clean and maintain equipment	3.00
Total	53.71

Combined Direct Cost

The total container materials, machine ownership, and direct labor cost of the recessed-top cartons was $11.07 per 1,000 half pints; for the cans filled in the main plant the cost was $4.82, and for cans in the subsidiary plant, it was $3.62.

Table 13.--Combined container, machine ownership, and direct labor costs to fill and handle 1,000 half pints, case study 5

Expense item	Recessed-top paper container	Cans - main plant	Cans - branch plant
	Dollars	Dollars	Dollars
Container	8.50	3.37	1.97
Machine ownership	1.51	.05	.35
Labor ($1.45 per hour)	1.05	1.40	1.30
Total	11.06	4.82	3.62

Case Study 6.--Dispenser Cans and Gable-Top Cartons

This case study was conducted in a large dairy which had a volume of 25,000 gallons of milk daily. The plant worked an extra shift to put out about 7,000 gallons beyond its planned capacity. Because of this production over planned capacity, the cold storage room was overcrowded and the efficiency of the workers in the cold room was reduced. Three gable-top filling machines accounted for most of the output. There also was a large dispenser can operation, more than 500 cans daily. Most of the school milk was packaged on a new machine that filled 75 half-pint gable-top containers a minute, and had a daily run of about 40,000 units.

A conveyor carried empty cases through a washer to the three filling machines. After each case was packed it was placed on a second conveyor which moved it to the refrigerator, where it was stacked until needed to fill a delivery order.

The dispenser cans were handled in another section of the plant. After the cans were stripped and washed they were put on a conveyor that moved them to the filling station. There they were sterilized by a spray and tubes were put on the outlet on the bottom of the can. The tubed cans were placed under a semi-automatic filler. After filling, the cover was put on and two wire seals were attached. Full cans were loaded out by a roller conveyor to a truck which hauled cans for general distribution half way around the building to the back entrance of the refrigerator. Cans for a large military order were stacked in a waiting refrigerated trailer which was dispatched directly to delivery points.

Materials Costs

Materials costs for the gable-top containers per 1,000 half pints filled were as follows:

Item	Dollars
Carton blanks	6.61
Wax	1.98
Wire	.05
Glue	.12
Cases	.16
Total	8.92

Materials costs per 1,000 half pints of milk filled in the dispenser cans were relatively low because the cans had an estimated life of 4 years. The costs were as follows:

Item	Dollars
Cans and covers	0.98
Seals	0.13
Tubes	0.53
Tags	0.03
Parchment	0.03
Total	1.70

Machine Ownership Cost

Ownership cost of the machine that formed and filled the gable-top containers was 26 cents per 1,000 half pints filled plus a production rental of 90 cents per 1,000.

The ownership cost of the can-filling machinery was 3 cents per 1,000 half pints filled.

Labor Requirements

One man fed empty carrier cases for all three filling machines to the automatic case washer. One man operated each filling machine and a second man on each machine packed full cartons into the carrier cases. An additional worker supplied carton blanks or flats to all three machines and cleared away empty boxes and scrap.

Four men were stationed in the refrigerator. One man stacked half pints, one man stacked quarts, and one man stacked half gallons. The other man assembled delivery orders on the outgoing conveyor.

Labor requirements to fill and handle 1,000 half-pint units on the gable-top machine were as follows:

Labor item	Man-minutes
Set up machine	.52
Supply empty cases	4.44
Fill and case	26.66
Store in refrigerator	13.33
Clean and maintain equipment	8.40
Total	44.46

In the dispenser can section two men reported at the beginning of the day shift. One stripped cans and put them through the automatic washer. The other cleaned and set up the equipment in the can filling room. After the cleanup he began to fill the dispenser cans. After about an hour he was joined by a third worker, and they both tubed, filled, and sealed dispenser cans for general distribution. Labor requirements are listed in table 14.

When the time came to start putting out the large military order, the three men on the job were joined by five more in an accelerated operation. This operation was not made a part of the case study.

Table 14.--Labor requirements to fill and handle 1,000 half pints (12.5 cans) in dispenser cans, case study 6

Labor item	2-man operation	3-man operation
	Man-minutes	Man-minutes
Set up equipment	0.75	0.75
Supply empty cans	2.88	2.88
Strip and wash cans	8.63	8.63
Tube, fill, and seal cans	25.75	38.50
Move cans, and store in refrigerator	14.25	14.25
Clean and maintain equipment	1.50	1.50
Total	53.76	66.51

Combined Costs

The total container materials, machine ownership, and direct labor costs of the gable-top containers was $11.17 per 1,000 half pints (table 15). For the 2-man can operation the cost was $3.05 per 1,000 half pints, and for the 3-man can operation $3.36 per 1,000 half pints, for an average of $3.20.

Table 15.--Container materials, machine ownership, and direct labor costs to fill and handle 1,000 half pints, case study 6

Cost item	Gable-top container	Dispenser can
	Dollars	Dollars
Container materials	8.92	1.70
Machine ownership	1.16	.03
Direct labor ($1.47 per hour)	1.09	1.47 (Avg.)
Total	11.17	3.20

Case Study 7.--Dispenser Cans and Flat-Top Cartons

This metropolitan dairy handled 35,000 gallons of milk a day. It had a large school milk business, about 45,000 half pints per day at the time this study was made. The dairy received milk seven days a week but packaged and delivered six days.

This dairy packaged about half its production in factory-made flat-top paper cartons. Three machines filled the paper containers. One machine was used almost exclusively for quart containers, one for quart, pint, and half-pint sizes, and the third almost exclusively for half pints.

The machine used primarily for half pints ran at a speed of 75 containers a minute, and put out about 31,000 units per day. The machine used for mixed sizes ran at speeds up to 120 containers a minute.

New containers were delivered to the dairy daily by tractor trailer from the factory, which was about 25 miles distant. There were three storage areas, one on the ground floor adjacent to the filling room, one on a mezzanine level, and one on a higher level. This combined floor area was about 2,000 square feet. A conveyor extended from a loading area in the rear of the plant, through the upper and mezzanine levels to the ground floor.

The daily delivery normally provided an adequate supply of containers for the next 24-hour period. In the event a delivery was delayed there was reported to be an adequate supply of containers on hand for all products in all sizes for another day or two. In addition the dairy maintained a nearby storage facility with a 3-day supply. Deliveries were reported as regular and reliable and there was some discussion of abandoning the standby warehouse.

The dairy had a dispenser can filling line with the various work stations linked by a roller conveyor. The washing operation was speeded by a mechanical scrubber and a semi-automatic spray washer. An average of 140 cans, equal to 11,000 half pints, were filled daily.

A glass operation was not included in this study. Both the paper and glass fillers were served by a chain conveyor system which carried the full cases to refrigerated storage.

Cost of Materials

The finished cost of the half-pint flat-top carton was $11.88 per thousand plus a $0.12 charge for delivery. The carrier case cost was computed at $0.12 per thousand half pints. The cases were of wood and had a life of 4 years.

The dispenser cans and covers were of tinned steel and were retinned three times during the course of their 27-month life. Following is a list of the material cost to package 1,000 half pints of milk in dispenser cans.

Item	Cost
Cans and covers	$1.86
Tubes	0.51
Closures	0.19
Seals	0.13
Tags	0.04
Parchment	0.04
Total	$2.77

Machine Ownership Cost

At the observed level of output the ownership cost of the filling machine for the factory-made flat-top carton was 22 cents per 1,000 half pints filled. There was no production rental. The ownership cost for the can filling equipment was 12 cents per 1,000 half pints filled.

Labor Requirements

One man kept empty cases moving through the case washer and on to the carton filling machines. Two men were assigned to each filling machine; one fed empty cartons to the machine and the other packed the filled containers into cases. One man maintained a supply of empty containers for the machines. He also did general work around the plant. Two men in the refrigerator room stacked the cases coming from the three paper container filling machines.

Man-minute requirements per 1,000 half pints for the flat-top carton were as follows:

Labor item	Man-minutes
Set up machine	1.85
Supply empty cases	3.63
Maintain carton supply at machine	1.82
Fill and case	26.67
Store in refrigerator	5.00
Clean and maintain equipment	3.91
Total	42.88

In the can filling operations, one man collected, stripped, and washed the empty cans. One man tubed the cans, one filled and covered the cans and two men in the refrigerator sealed and stacked the cans.

Labor requirements per 1,000 half pints filled in dispenser cans were as follows:

Labor item	Man-minutes
Set up equipment	2.73
Move cans to conveyor	1.50
Knock off cover and strip	5.75
Wash cans	6.50
Rinse and put on conveyor	4.00
Attach tube and apply tube closure	6.50
Fill, insert parchment and cover ..	3.12
Remove from conveyor and stack	2.25
Seal and tag	7.00
Clean and maintain equipment	5.45
Total	44.80

Combined Costs

The total container materials, machine ownership, and direct labor costs of the flat-top cartons was $13.65; for the cans it was $4.27 (table 16).

Table 16.--Containers, machine ownership, and direct labor costs to fill and handle 1,000 half pints, case study 7

Expense item	Flat-top paper container	Five-gallon dispenser cans
	Dollars	Dollars
Container materials	12.12	2.77
Machine ownership	.22	.12
Labor (1.85 per hour).......	1.31	1.38
Total	13.65	4.27

ADJUSTED TOTAL COSTS IN PLANT BY TYPE OF CONTAINER

At the conclusion of the case studies it became apparent that in-plant packaging and handling cost comparisons based on 1,000 half pints of milk packaged, tended in some respects to weight the figures against the experimental tetra containers because of their relatively low volume of production. This was particularly true of tetra machine ownership costs which ranged from $0.91 to $2.78 higher per 1,000 half pints filled than the ownership costs of the conventional machines with which they were compared. The tabulation which follows is designed to:

(1) Level the costs of well-established conventional container operations by assuming a common wage of $1.85 an hour, and by eliminating machines with an output of less than 60 half pints per minute. No changes were made in materials or machine ownership costs. Dispenser cans, not being new insofar as the in-plant operation is concerned, are included in this "well-established container" grouping.

(2) Estimate the probable tetra costs at the same wage in the same plants on the basis of an assumed output of 24,000 half pints daily during the 180-day school year and also during the entire year of 310 working days. This level was twice as high as any tetra output actually observed but fairly near the average level of the comparable conventional machines observed. Only machines with the automatic packout, now standard equipment, were included. The principal effect of these adjustments was to charge the annual tetra machine ownership cost against a greater number of units, thereby reducing the cost per unit. Production rental payments moved into lower brackets and spreading total machine setup and cleanup times over the higher volume of production also slightly lowered the labor costs per unit of output.

Under the conditions above, the combined costs of containers or container materials, machine ownership, and direct in-plant labor per 1,000 half pints of milk packaged were computed as follows:

Type of container	Range of total adjusted costs
Glass bottles	$ 6.32 - $10.22
Conventional paper cartons ..	11.30 - 13.65
Tetra, school milk only	7.87 - 8.44
Tetra, year around production	7.61 - 8.18
Dispenser cans	3.29 - 5.18

GENERAL SUITABILITY FACTORS

Utility Requirements

Utility requirements in this section are based for the most part on estimates of plant operators or on specifications prepared by the machine manufacturers. Utility requirements for washing and filling containers--by type of container--are listed in table 17.

Table 17.--Utility requirements per hour to wash and fill containers, by container

Container	Rate of output	Water	Steam	Electricity	Gas
	(Half pints)	(Gallons per hour)	(Pounds per hour)	(Kw. per hour)	(Cu. ft. per hour
Bottle	90/min.	750 (hot)	---	9.7	---
Bottle	66/min.	300 (hot)	---	3.2	---
Gable-top carton ..	75/min.	14 (cold)	60	9.2	---
Flat-top carton ...	75/min.	---	---	2.2	---
Recessed-top carton	64/min.	120 (cold)	---	13.0	2,220
Tetra container ...	75/min.	---	---	5.6	---
	Cans				
Dispenser can	30/hr.	300 (hot)	---	---	---

Can fillers observed were operated by compressed air tapped from a central source. The electric power required to compress the air used only by the filler was not determined. Hot water requirements listed for washing cans were based on a manual washing operation. The amount of hot water needed for combined manual and machine washing was not obtained.

One dairy had its own water source; others paid from 18 cents per 1,000 gallons to more than twice that much. Dairy estimates of their cost of heating water ranged from $1.50 to $4.00 per 1,000 gallons.

The net cost of electricity ranged from 0.82 cent per kilowatt hour to 2.07 cents. One plant near a producing area paid 20 cents per 1,000 cubic feet of natural gas.

Space Requirements

Storage Space

The storage space problem of the dairy operator is in three parts:

(1) Storage of new containers or container materials
(2) Refrigerated storage of packaged milk
(3) Storage of carrier cases of empty bottles, empty cases for paper cartons, and empty cans

(1) Rolls of paper to form the tetra container required the least amount of space on an equivalent unit basis, and glass bottles and cans the most space. Dry storage space required for new containers or container materials per 1,000 half pints was computed as follows:

Container	Cubic feet
Glass bottles	19.97
Recessed-top paper cartons	0.75
Gable-top cartons (including slab wax)	1.70
Flat-top cartons	11.90
Tetra cartons	0.35
Dispenser cans	17.55

One dairy maintained an inventory of new bottles sufficient to provide replacements for 2 weeks. Another dairy, which recently had made a large purchase of used bottles, had enough on hand for about a year.

The gable-top paper blanks or flats must be held in warm, dry, controlled storage for from 2 to 4 weeks before use to bring the paper to the optimum moisture level. This requirement is not reflected in the above tabulation. The wax in which the paper is dipped also requires considerable care in storage, particularly when it is maintained in a liquid state.

New factory-made, flat-top cartons required the greatest overall storage area but they were light in relation to volume and they did not necessitate heavy construction or any special atmospheric controls. When dairies were on a daily delivery schedule, a 2- to 3-day inventory was reported to be adequate to guard against contingencies.

Recessed-top paper carton components, rolls of paper for the tetra container, and dispenser cans presented no particular storage problem. In the dairies visited, a 3- to 6-week supply of components or paper was on hand. One dairy had 20 new cans in storage. The others maintained a used can inventory large enough to provide a margin of safety.

(2) Refrigerated storage conditions did not require modification for any particular container type. Floor space requirements are listed in table 18. There was no great difference among containers.

Table 18.--Refrigerated floor space required for storage of 1,000 half pints of packaged milk in alternative containers

Type of container	Type of case	Capacity of case or can	Height of stack	Floor space required for 1,000 half pints
		Half pints	Cases	Sq. ft.
Bottles	Wood	24	10	5.30
Conventional paper	Wood or metal	48-66	6-8	3.09-4.74
Tetra carton	Metal	18	10-11	4.57
			Cans	
Dispenser can	None	80	2	4.77

(3) The floor area used for cases of empty bottles, empty cases for conventional paper cartons, and for empty cans was slightly less than the refrigerated storage area for an equivalent number of units because the empties usually were stacked higher than filled containers. Space requirements for the empty tetra carrier cases were much lower--about 50 percent--because the empty cases nest (fig. 6).

Machine Space

The tetra filler is an extremely compact machine and with one exception requires appreciably less floor space for installation than conventional paper fillers or washer-bottlers of a comparable rate of output.

The tetra machine does not completely occupy a floor area of 11 by 4¼ feet, or approximately 47 square feet. A comparable conventional machine that forms and fills paper cartons occupies about 183 square feet. (Although its floor requirements are modest, the tetra needs a ceiling high enough to accommodate a machine that is 12½ feet from base to top of paper reel.)

The only comparable conventional machine that can be installed in about the same floor space as the tetra machine is that which fills the flat-top cartons. However, this machine requires working space for two men--one to supply empty cartons and one to pack them in cases--whereas only one man is needed on the tetra filling operation.

The dispenser can filler requires very little space. However, the working space requirements as observed were so high that the can operation could be classed only with those of the larger machines.

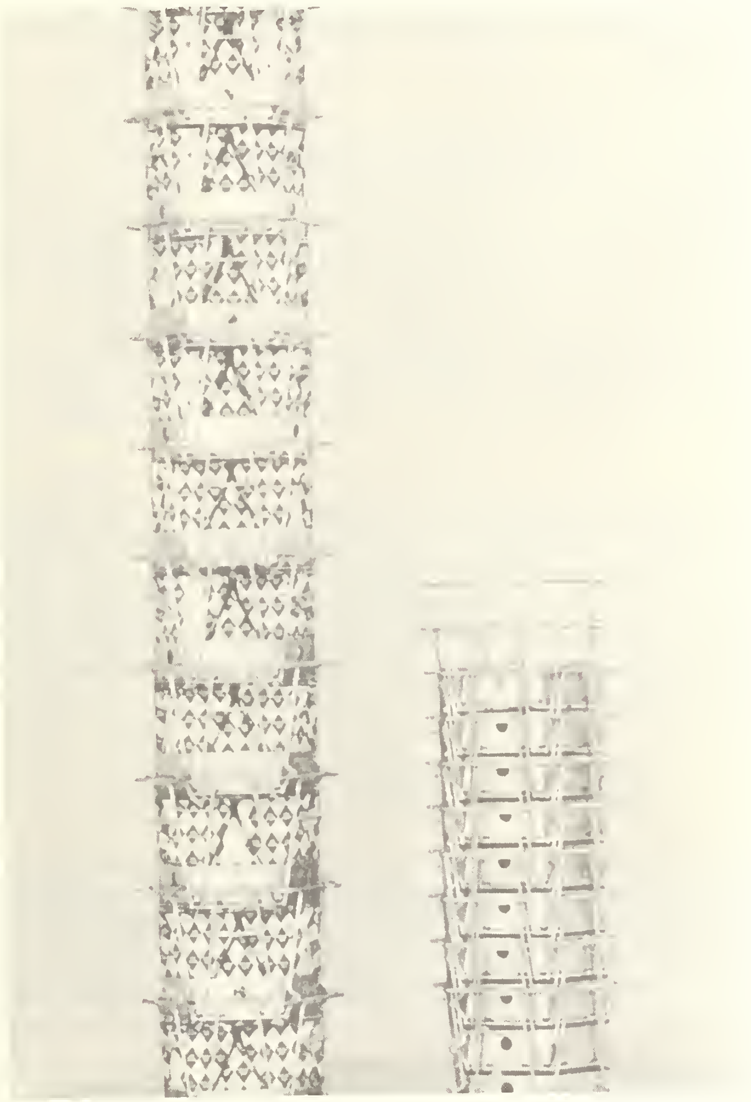

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Figure 6.--A nested stack of 10 empty tetra cases is only about half as high as a stack of 10 full cases. Thus, 20 empty cases can be stored in the same space required by 10 full cases.

Loading the Truck

Individual drivers and helpers tended to load small cases of packaged milk into trucks at a faster pace than they loaded large cases. However, because they contained so much more milk, the larger cases of from 60 to 66 conventional paper half pints were about 40 percent more efficient in the use of labor in the loading operation than the smaller cases with 18 tetra containers, or 20 to 24 bottles. There was little difference between the larger cases and dispenser cans.

Drivers reported that stacks of the small hexagonal tetra cases were less stable than stacks of broader-based rectangular cases for glass and conventional paper. This problem of instability was solved by securing screw eyes in the truck walls and looping a length of rope around the tetra stacks, or by wedging tetra stacks between stacks of more stable cases of conventional containers.

Cans did not use available space to the best advantage. In no delivery truck observed were they stacked, when full, and drivers complained that they fit poorly in a mixed loading pattern. No truck observed had any special fittings for cans.

On the basis of an equal volume of milk, there was no substantial difference in the loading weights among the small cases of tetra containers, dispenser cans, and conventional paper cartons in large cases; 1,000 half pints of packaged milk or milk in cans weighed between 720 and 750 pounds. The same amount of milk in cases of 24 half-pint bottles weighed approximately 1,450 pounds. These weights are based on limited case study observations and are not necessarily representative.

Making Room to Work the Load

For the wholesale driver who starts out with his truck filled to capacity or near capacity, one of the most irksome problems is to maintain room to work his load. Although he plans his loading carefully to make sure that the first items to be delivered are near the doorway, the driver eventually must open up space to get into the innermost corners. After almost every large delivery the driver is compelled to rearrange his load to bring items required at the next stop within reach.

When delivery in glass is made, usually an equal volume of empty bottles is returned and there is no space saving unless the cases can be stacked higher. Some drivers, particularly if they are carrying a high percentage of glass, occasionally solve the space problem by leaving several stacks of empties in an alley or vacant lot, to be picked up on the way home, although the temporary storage spot sometimes requires a longer trip or results in losses.

After conventional paper containers have been delivered, some space can be gained at the expense of stack stability by putting one empty case on end inside another empty case. The case inside protrudes above the sides of the case in which it has been placed, making it necessary to position the next case above upside down.

Empty tetra cases can be nested. Following a delivery of two stacks of tetra containers the empty cases can be consolidated into a single stack. A stack of 10 full tetra cases is 62 inches high; a stack of 20 empties is almost the same.

Empty dispenser cans are somewhat easier to stow than full cans. They are blocked in and stacked one on top of another, either upright or on side.

Delivery to the School

A few schools permitted drivers to stack cases of milk just outside the service or cafeteria door in the early morning hours, or just before serving time. Such milk usually was moved inside by the school janitor. Also, at a few schools the drivers carried or trucked the milk inside to a walk-in refrigerator and stacked the full cases there. Under these circumstances the type of container used exerted no substantial influence on the time required of the driver to make the delivery.

For small orders or occasionally where there was a flight of steps to be climbed, the drivers carried cases of conventional paper containers two at a time--like suitcases--one in each hand. Dispenser cans also were carried this way. A stack of five to seven tetra cases was carried in a two-hand grip. Carrying cases of bottles by hand, because of the weight required considerably more effort per unit of payload. The amount of bottled milk that could be moved in a two-case "suitcase" carry was rather small. Four cases of bottles carried in a two-hand grip required greater than average strength and was rarely seen, yet still moved less milk than a single carry in other containers. The most efficient carries were in dispenser cans and in large cases of conventional paper cartons (table 19).

For large orders, a handtruck was used wherever possible to move the half-pint containers. Dispenser cans in all deliveries observed were moved only by hand. The larger cases of conventional paper containers bore the most milk in a single trip of the handtruck and smaller but comparatively heavier cases of bottles moved the least milk. The tetra containers carried more milk than bottles did in a single trip, but considerably less than conventional paper containers.

At most schools visited, the milk was put into a refrigerated box or series of boxes positioned along the cafeteria serving line. Where dispenser cans were used, the refrigerated dispenser units were replenished and additional cans were stowed in a refrigerated locker.

Table 19.--Usual quantity of milk observed being moved by driver in single carry or in single loading of handtruck

Type of container	½ pints per case (or can)	Hand carry: Cases (or cans)	Hand carry: Total ½ pints	On handtruck: Cases	On handtruck: Total ½ pints
	Number	Number	Number	Number	Number
Bottles	24	2	48	7	168
Cartons	48-66	2	96-132	5	240-330
Tetra	18	6	108	11	198
Dispenser can	80	2	160	1/	1/

1/ Use of handtruck not observed.

In almost all schools which received milk in half-pint units, authorities required that the conventional containers, both paper and glass, be removed from the cases and hand-stacked or put away in the refrigerators. They contended that full cases of the conventional containers were too heavy to be handled by women working in the cafeterias or by children assisting with the serving.

Most of the schools receiving milk in tetra containers accepted full case because they were lighter in weight and easier to handle. One school system, with coolers into which tetra cases would not fit, required removal of the containers. These containers were simply dumped from the case directly into the cooler boxes. There was no need to set each container carefully right-side up because tetra packages have no specific tops or specific bottoms. Any of its four surfaces may serve as a bottom. Dumping a case of containers all at one time resulted in no appreciable loss of time. However, if the milk was not served the day of delivery, the containers in the bottom layer sometimes were pressed out of shape.

No two schools were exactly the same in layout, in number of steps to be climbed or in distance from unloading area to refrigerated space; and the size of the milk deliveries observed varied from 25 half pints for a small kindergarten to 1,450 half pints for a large high school.

However, on a unit basis in a large number of observations, consistent differences appeared among the delivery times of the various container types. Dispenser cans were fastest and the tetra was close behind. Requiring considerably more time were the three conventional types of paper containers.

The greatest amount of time was required by the bottles because of the necessity to collect empties and occasionally, when it was not done at the plant, to strip off caps and remove straws.

Average times to deliver 1,000 half pints of milk and to place in refrigerated cabinets on cafeteria line or in refrigerated dispenser units, by type of container, follow:

Container type	Man-minutes
Glass bottles	46
Conventional paper cartons	36 to 38
Tetra containers	20
Dispenser cans	16

Serving in the School

During the milk serving hour, researchers visited at least two schools using each of the conventional types of containers, six schools using the tetra container, and four the dispenser cans.

Most of the schools served milk with a noon meal; some served it as a mid-morning snack, and a few served it both morning and noon. If the school had a cafeteria, and most of them did, both recess milk and luncheon milk were served there. A few schools served recess milk in the classrooms.

The schools, as a rule, staggered the release of classes at luncheon time to encourage an even flow of children through the cafeteria line.

Conventional Containers

In a typical school using any of the conventional paper or glass half-pint containers, the children first picked up a tray, and a fork and spoon wrapped in a paper napkin. At subsequent stations along the serving line, the children picked up, or were given a main plate, a dessert, a container of milk, and a straw. For the most part, the paper cartons were still sealed; the bottle caps were pierced to admit a straw.

With loaded trays, the children moved to the tables, ate with solemn concentration, picked up trays and carried them to the disposal station. There, leftover food was scraped off, silver was tossed into a wire basket, plates, dishes, and trays were stacked. Paper containers, napkins, and straws were dropped into a trash barrel. A stack of empty cases was positioned here if bottles were to be returned.

There was not a great deal to choose among the conventional single-service containers. In general, all gave satisfactory service. Cafeteria workers in several schools did comment on occasional leakage of wax-coated cartons, and in two schools they said that there sometimes were complaints of free wax in cartons that were coated in the dairy.

The disposal of the bottles required more direct labor. In one school a janitor was assigned to position an empty case as each preceding case was filled. In another school an older boy did this chore and a second boy removed bottle caps and straws.

Tetra Containers

The serving of the tetra container was about like that of the conventional paper containers. Before a notching device was developed to facilitate tearing open the containers, the peaked tops were scissored off by cafeteria workers or teachers, and the containers were served with a straw inserted in the aperture.

After development of the notching device, all schools visited served the containers completely sealed. Although researchers considered the tetra to be among the more difficult containers to open, the children apparently mastered it with no undue difficulty.

In some schools toward the end of the lunch hour, it became necessary to replenish the milk in the cafeteria line coolers with an additional supply from the main refrigerator. With the small, light cases, it was easier to move the tetra than any other container. Most of this work was done by women cafeteria workers or student helpers.

The tetra container has a comparatively low center of gravity and a broad base. The chance of the container tipping while being carried on a tray was almost nil.

The empty tetra containers, like the conventional paper cartons, were dumped into trash barrels after the meal. Being of light construction, the tetra empties could be squashed flat and compacted to save space.

Children were intrigued by the unusual shape of the tetra container. In many schools, milk consumption increased when the new container was first introduced, but consumption slipped back to the old level after the newness wore off.

Several cafeteria managers reported that children drinking through straws seemed to leave more milk in the tetra containers than in the others. They said that if the children would tilt the milk into a corner, the milk could be easily siphoned out through a straw--but that the children "just won't bother."

A grinning high school principal said that the tetra containers had confronted him with a short-lived disciplinary problem. Some of the older boys discovered that a full tetra container with its top torn open could--when vigorously squeezed--be made to perform like a squirt gun. However, following their assignment to a cleanup squad, the boys lost enthusiasm for the new diversion.

In one city the school authorities reported that they had had an outbreak of leaking tetra containers after a considerable period of trouble-free service. About a third of the schools changed over to conventional containers. In three other cities the school cafeteria people reported they had had no tetra leakers.

The cafeteria managers tended to favor the container in current use and sometimes seemed rather harsh in criticism of containers formerly used. This tendency was especially apparent where the managers had had a voice in the selection of the current container. The cafeteria people in general tailored an efficient milk serving operation to fit any container that the purchasing authorities made available.

Dispenser Cans

Four schools which received milk in dispenser cans all served it in glasses. Two of the schools had two 3-can dispenser units, and two had a single 3-can unit.

In each school, whether it had one or two dispenser units, cans which ran dry early in the serving period were replaced with full cans. For example, an installation with two dispenser units might start out with six full cans--enough milk for about 480 servings. If 600 servings were anticipated, the first two cans to become empty would be replaced, thus making available about 640 servings.

None of the boys making the can exchange appeared to have any difficulty and in no case did they interrupt the flow of children through the serving line. All boys assigned to the task were at least eighth graders. Serving of milk from cans was not observed in any elementary school with less than eight grades.

All dispenser installations were located at the end of the cafeteria lines. Two older boys drew the milk into glasses, whether there was one unit or two. One person drawing milk could not keep pace with the children who moved through the cafeteria lines at from 8 to 13 per minute. Early attempts to train each child to draw his own milk were reported failures because of excessive spilling.

Full glasses of milk for first graders were placed on the tables just before the children took their places. All the other children carried their own milk. About 8 ounces of milk was put into 10-ounce glasses, leaving a good margin to protect against spilling which, nevertheless, did occur.

After the meal the children took their trays to a disposal station. In a typical school, one student helper placed empty glasses in rubber-covered wire racks and carried them to a nearby spray washer. A second boy ran the racks through the washer and returned the clean glasses to the two boys at the dispenser units.

While cleaning up after the meal the regular cafeteria workers removed empty cans from the dispensers and put them outside. Nearly-empty cans were drained and also removed. At one school the cans were hosed out by the janitor. The other schools did not rinse the cans.

Serving milk from cans necessitated the purchase of refrigerated dispenser units, glasses, a glass washer, and washing materials, and the use of considerably more labor and hot water than did serving from any of the half-pint containers. On the other hand, the refrigerated dispenser units reduced the need for refrigerated cabinets along the cafeteria serving line.

It required from about 120 to 250 man-minutes of direct labor to serve 100 children. This included paid cafeteria workers and student helpers but not the teachers who did yeoman service in maintaining order and seeing to it that the tables were clean before being vacated. Times were taken only from the moment the first child started through the cafeteria line until the last child returned his tray and left the cafeteria. Food preparation and cleanup times were not included. From 20 to 35 percent of the serving time was charged to drawing milk, and washing and handling glasses when dispenser units were used. This contrasted with from 5 to 10 percent of the serving labor occupied by milk distribution in schools using half-pint containers.

The student helpers who served the milk and handled the glasses received compensation in the form of free meals which cost the schools very little. However, a recent unpublished USDA study of a large commercial cafeteria operation indicates a cost of $9.60 to handle, wash, and return 1,000 glasses to the serving station. Eighty percent of this cost went to pay for direct labor at a rate of $1.49 (including fringe benefits) per hour; 12.5 percent was for hot water, and 7.5 percent for glass replacements, cleaning materials, and depreciation of equipment.

The schools all reported they bought their dispenser units, glasses, and washers with savings made on purchases of milk in cans, which was priced lower than milk delivered in half-pint containers.

Paper cups were not used in any of the schools visited. Cups suitable for milk were reported to be available at from $7 to $9 per 1,000.

PRICES RECEIVED FOR MILK IN ALTERNATIVE CONTAINERS

Tetra Containers

In two cities, milk in tetra containers was priced to schools at the same rate as milk in conventional half-pint containers.

In a third city, the price on the tetra was set a half cent below the tag on conventional containers. The schools were happy to receive the reduction and the dairy operator was glad to give it. The tetra materials, machine, and direct labor costs alone were a third of a cent below comparable costs of the conventional container which had been in use. Furthermore, the tetra installation permitted the dairy to handle a comparatively large volume of school business, yet avoid substantial overtime operation of its conventional machine.

In a fourth city the distributing dairy cut the school price of milk in the tetra container a quarter cent below half pints in conventional containers. A good volume of tetra business resulted. At the peak volume the net saving

on the tetra operation--as compared with the conventional--more than justified the cut, it was reported. However, competitors united in protest. At the end of the first contract period the price was raised back up to the general market level. Now school authorities protested. Forty-five percent of the orders for milk in the tetra containers were shifted back to conventional containers.

Dispenser Cans

Researchers gathered 5 examples of the pricing of milk delivered in 5-gallon dispenser cans. In all cases, milk in cans was priced from $10.00 to $18.13 lower per 1,000 half pints than milk in conventional half-pint paper cartons.

In the dairies quoting the prices, combined materials, machine and direct labor costs for filling and handling the cans were but $5.07 to $9.64 lower per 1,000 half pints than comparable costs for the half-pint paper containers.

The price reductions on milk in cans in excess of the principal in-plant cost savings ranged from $3.76 to $9.38 per 1,000 half pints (table 20).

Table 20.--Price reductions per 1,000 half pints granted on purchases of milk in 5-gallon dispenser cans as compared with milk in conventional half-pint paper containers; principal in-plant cost savings per 1,000 half pints from use of cans as compared with conventional paper half-pint containers, and excess of price reduction over principal savings

Item	Dairy plant				
	A	B	C	D	E
	Dollars per 1,000 half pints	Dollars per 1,000 half pints	Dollars per 1,000 half pints	Dollars per 1,000 half pints	Dollars per 1,000 half pints
Price reduction granted	10.00	12.50	17.50	11.66	18.13
Principal in-plant cost saving	6.24	7.44	8.12	5.07	9.38
Excess of reduction over saving	3.76	5.08	9.38	6.59	8.75

ADVANTAGES AND DISADVANTAGES OF NEW CONTAINERS

Tetra Containers

Advantages of the tetra containers were:

1. Materials costs ranged from \$2.91 to \$3.72 per 1,000 lower than those of conventional paper containers which were formed and filled in the dairy plant. They were between the high and the low costs observed for bottles and caps.

2. With an inexpensive automatic packout, the tetra machine was operated by one man. Comparable machines for other containers required two men. None of the conventional machines were equipped with an automatic packout. It is now standard equipment on the tetra.

3. The tetra machine was simple in design and had comparatively few moving parts. In consequence, cleanup and maintenance time was but one-third to one-half that required by most of the conventional machines.

4. The tetra operation saved space. The machine was extremely compact, dairy operators liked to say they could store their new paper in a phone booth, and empty tetra cases nested.

5. Utility requirements were lower for the tetra operation than for any other except that of filling the factory-made flat-top paper cartons.

6. The time required to deliver tetra containers to refrigerated cabinets on school serving lines was substantially less than that required by conventional half-pint containers.

7. Full cases of 18 tetra containers were light enough to be carried easily by women working in the school cafeterias and by student helpers.

8. Empty tetra containers could be crushed flat, facilitating disposal.

Disadvantages of the tetra container were:

1. The tetra filler lacked the flexibility of the conventional machines which could switch from half pints, to pints, and to quarts with only minor adjustments. The tetra machines studied formed and filled half pints only.

2. The ownership cost of the tetra machine was relatively high per unit of output at the low levels of production observed.

3. The hexagonal carrier case ran counter to a trend to increase handling efficiency by standardizing carrier cases. The relatively smaller base of the hexagonal case decreased the stability of stacks and necessitated conveyor adjustments, if existing systems were to be used.

4. Because of its unusual construction and appearance, the tetra container more often than not encountered above average sales resistance at the wholesale level.

Dispenser Cans

Dispenser cans were compared only with conventional single service half-pint paper containers.

Advantages of the can were:

1. The combined cost to the dairy plant of can and accessories, filling and washing equipment, and direct labor ranged from $5.07 to $9.64 lower per 1,000 half pints of milk.

2. Deliveries to schools required less time.

3. Milk served in cans was colder and in consequence had a greater appeal for the children, some cafeteria managers reported.

4. Milk in cans could be purchased at prices from $10 to $18 per 1,000 half pints below comparable prices in conventional single service paper containers.

Disadvantages of the can were:

1. Hot water and space requirements to wash, handle, and store cans in the plant were relatively high.

2. Empty cans often were returned to the plants in an extremely dirty condition. In hot weather, especially, dairy operators reported they were forced to use caution to prevent sour odors from contaminating fresh products.

3. In the schools, milk from cans was drawn into glasses or cups and was more often spilled than milk in half-pint containers.

4. Drawing milk from dispenser cans into glasses and handling, washing, and returning the glasses to the serving station occupied from 20 to 35 percent of the peak cafeteria labor force. Student helpers did most of this work in return for free meals. (Studies in a large commercial cafeteria operation indicated that this method of serving cost 0.96 cent per glass, 80 percent of the cost being for labor.)

5. Use of cans did not permit flexibility in ordering milk; it must be taken in units of 5 gallons--or 80 half pints. Thus, a cafeteria manager, who needs at least 275 half pints, must order 320.

6. The dairies made a smaller margin of profit on milk sold in cans than on milk in conventional half pints.

DISCUSSION

Despite the elements of risk associated with any new development, the tetra operation had certain inherent economic advantages which should appeal to dairies in a position to compete for a good volume of school business.

The tetra machine ownership costs were comparatively high at the low levels of output observed. However, with an increased volume of business, unit costs would decline; and the simplicity of the machine design suggests that its price may be reduced when the costly developmental period is over.

Although a man is saved by the automatic packout, this saving could be lost unless the overall filling and handling operation is carefully planned and set up. Researchers were surprised to find that hand-trucking stacks of full cases to refrigerated storage required less labor than the observed movement of single cases by conveyor. The machine operator had ample time to stack the cases as he removed them from the filler. When the full stack was moved, no additional labor was required to build a stack in the refrigerator.

Tetra leakers in the routine day by day operations observed in four case studies were almost nonexistent. However, occasional wholesale batches of tetra leakers have been reported with consequent loss of prestige for the container. The leakers were attributed to experimentation with the paper manufacturing processes during the developmental period, and improper storage of the paper at the dairy. Supporters of the tetra declare that they now know how to store the paper to prevent deterioration, and that the paper manufacturing problems have been solved.

Children seemed to like the extremely unconventional shape of the tetra container. However, school authorities, who purchased the milk, initially regarded it with skepticism. Strong and imaginative salesmanship by the dairy was needed to introduce the new container unless a price advantage was granted.

Cost savings gained in the plant by use of the tetra justified small price reductions. However, a price cut granted in one of the cities visited aroused considerable opposition in the trade. When the old price was restored to bring peace, almost half the new tetra business was lost. In a second city a price cut worked out to the mutual satisfaction of both the dairies and schools.

Washing, filling, and handling the dispenser can was largely a manual operation. Direct labor requirements were higher than for half-pint containers. However, what machinery and equipment there was, was inexpensive. In consequence, machine ownership costs were lower. Furthermore, the sturdy cans--with an occasional retinning--could be used over and over again for as long as four years. This made possible major savings.

Serving milk in schools from dispenser cans added to labor and hot water requirements, and necessitated the purchase of dispenser units, washing equipment and cleansing materials. However, with price reductions in excess of savings within the dairy plant, it appeared that use of dispenser cans was advantageous for the schools. If milk in conventional half-pint containers was fairly priced, then milk in dispenser cans was under-priced.

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This report is one of a series evaluating new containers which have shown promise of helping agriculture do a better marketing job.

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